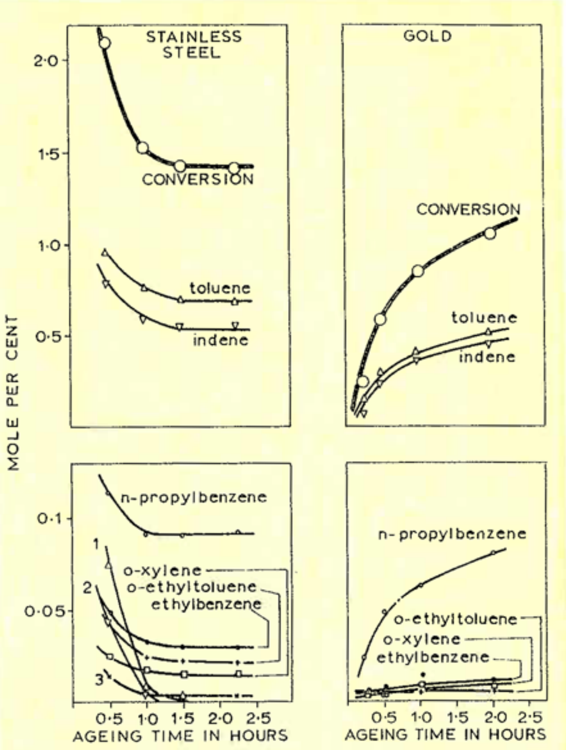

Ageing effects of AISI 316 stainless steel and gold-lined carbon-steel as reactor wall materials.
Temperature 500°C, spacetime 100 seconds, molar ratio hydrogen-to-indan 10, total pressure 80 bar.
1 Styrene
2 1, 2, 3-trimethylbenzene
3 m/p-xylene

steady conversion level has been established, while the yield of the reaction products is quite different from that obtained with the stainless steel reactor; it varies only slightly with the ageing time, and the composition also indicates that with short ageing times only the three types of reactions previously mentioned are operative. It is interesting to see that the overall indan conversion and the product composition in the gold reactor tend to the steady state levels observed in the aged AISI 316 reactor. It may thus be concluded that the catalytic effects of both aged AISI 316 and gold are similar, although they differ quite significantly in the pre-aged stage.

This was tentatively explained by the formation of carbonaceous deposits on both the stainless steel and the gold during the ageing period (3). These deposits cover more active and less selective sites on the AISI 316 reactor wall, for example nickel and chromium crystallites, and provide new sites which are less active and more selective towards dehydrogenation, α- and β-ring opening. In the gold reactor no active sites are present initially, so that the conversion is very low. During ageing active sites of the type formed in the AISI 316 reactor are created, and cause the conversion to increase without a significant change in yield. Finally, both the AISI 316 and the gold are so transformed by ageing that the effect of either wall material is approximately equal on the hydrocracking of indan. The activity of steady-state reactor walls may be derived from free radicals which are likely to be present in carbonaceous coke deposits. Extrapolation of the conversion to zero time indicates a very low or even zero conversion.

This means that the thermal hydrocracking of indan, more particularly the α-ring opening, proceeds with a significant rate only in the presence of a reactor wall with a specific activity; in other words although thermal hydrocracking proceeds homogeneously in the bulk of the fluid phase—because variation of the surface-to-volume ratio had no effect (3)—it is most likely that the reactions are initiated heterogeneously at the wall of the reactor.

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Selective Gold Catalysts

While gold is not yet widely used in catalysis, its stability in acidic and alkaline media suggests that it has promise in certain specific processes as a highly selective catalyst. Gold's electronic configuration indicates that its catalytic activity will be less than that of various transition metals but gold on suitable supports may prove more efficient.

Studies have now been carried out by G. D. Kazakova, Yu. S. Mardashev and B. V. Erofeev at the Moscow State Pedagogic Institute named for V. I. Lenin and these show that CaF_2 is superior as a support for gold compared with the other ionic supports NaF, KCl, CsCl, RbCl, KI, and $BaCl_2$ for the dehydrogenation of alcohols and for the conversions of benzene and cyclohexane (*Dokl. Akad. Nauk S.S.S.R.*, 1975, **220,** (5), 1106–1107).

Catalysts containing 0.3 per cent gold were tested for activity at 200 to 400°C. Results showed that 0.3 per cent Au/CaF_2 had the highest activity for each dehydrogenation reaction and that this is connected with the greater stability of gold atoms in the crystal lattice of calcium flouride than in the other supports.